

**Education and curriculum development in Photogrammetry in India**

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**Introduction**

Photogrammetry technology is gaining popularity among the user communities due to its varied advantages and applications in many fields. Photogrammetry is a part of remote sensing, which involves viewing objects stereoscopically to make accurate measurements. The word photogrammetry, like many other words got its name derived from Greek words; photo - meaning light, gramma means graphy / drawing and metry meaning measurement. Photogrammetry is defined as the art, science of obtaining reliable information through the process of recording and taking measurements from photographs.

This technology enhances vision so that objects, areas are imaged with overlap with the help of high precision metric cameras. In the recent years due to the requirements of large scale maps with more accurate height information of the buildings and terrain, Photogrammetry has become more popular and getting more popular in India. There is a need to have trained and highly skilled manpower in this emerging area. As the rate of science and technology development is going more and more faster in the field of photogrammetry, the methods and scopes of the education and training need to change and should be able to cope with the advancements. Because of the integration and development of photogrammetry with GPS, LIDAR and GIS, Photogrammetry curriculum has become a compulsory one of the professional technology.

**Why Photogrammetry**

We all have seen some kind of maps in our life. With these maps we are able to represent the shape of the object, place, extent and boundary of the country etc., If we could imagine these maps in three dimensional. Yes, it will be really of great use in understanding the topography of the land. We can see the Himalayan ranges with its crest and trough. We can see the Deccan plateau, the Indian ocean, the western and eastern ghats in its relative elevations. We can have a better idea on the estimating the distance between two places, volume, surface area, slope etc.,. These types of maps are possible to prepare with the Photogrammetry technique. The same types of maps are possible to prepare with conventional ground survey technique but Photogrammetry is used for the following advantages

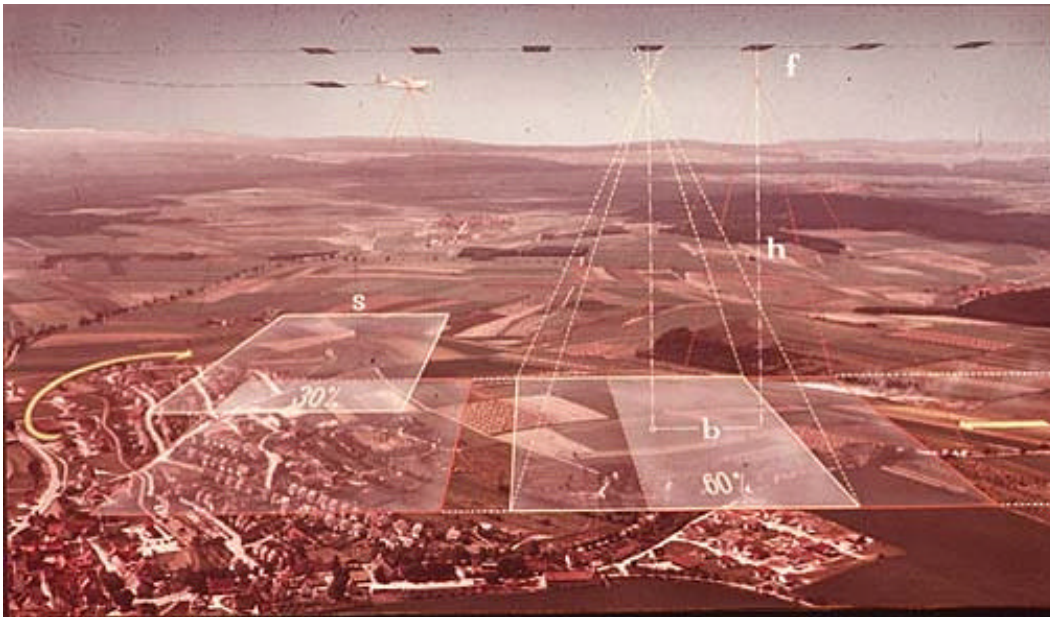
- ?? The ground method is a long-established process and is relatively slow and expensive
- ?? Can be mapped at office irrespective of different weather conditions
- ?? Less Ground work
- ?? Cost and time effective.
- ?? More accurate, precise 3D mapping
- ?? Error due to slope is removed.
- ?? Permanent record of physical features - Photo
- ?? So verification of data at office is possible.
- ?? Easy updation possible- contributing to ease of maintenance.
- ?? Slope of the fields are also generated which are very valuable.

**Principle of Photogrammetry**

Photogrammetry is mainly known for its stereo-scopic model for determination of height. The 3 dimensional view of a photographed object kindled the imagination of various scientists, which

has led this field to extent of virtual reality - 3D animation. A 3-dimensional model gives a better way of understanding about the nature of the object rather when it is shown as elevation, top view or section. A very common man can also be able to appreciate the usefulness and for assessment. The basic principle of photogrammetry is our normal human eye - our vision. We can be able to feel the height difference of one object relative to the other, if we see with our two eyes. With one eye we may not be able to feel the height difference.

Stereo scopic vision of Photogrammetry has its principle here. If we would be able to see one object from two different positions (left eye and right eye) we can get the stereo (3D) view. So if a same object is photographed from two different positions relative to our eyes, we will be able to get the 3D picture of the object. i.e., depth perception is achieved. This forms the basic principle in photogrammetry. To view the same object from two different positions aerial photos from airplanes are taken with regular overlap successively to have a seamless stereo view of the entire area. These overlapping photographs if could be kept in the same orientation as at the time of photography the 3D view of the object is created. The 3D model thus created should then be used for taking measurements which is the main objective of photogrammetry. For taking a measurement, the 3D model need to have some reference to start with. To refer the model to some co-ordinate system, for taking exact measurements as it is in the ground reality, control points, normally referred as ground control points are collected. After having oriented the 3D model to the ground reality, any measurements taken thereafter are as same as it is taken in the ground. To perform all these operations the photogrammetric process called interior, Relative and absolute orientation were performed.



### ***Aerial Photography***

The stereo captured maps created only can have the accurately interpreted and captured features only. As such it don't have information of the nature of terrain. Whether it is of steep slope, gradual slope, highly undulated terrain, hills / valley.... Nothing will be able to get from that. To represent the terrain, Digital Elevation Model (DEM) which is a continuous representation of the change in the elevation of the terrain and the contour (lines joining equal elevations) can be generated. For the people who may be interested in working with the monoscopic images for mapping, ortho photographs (having uniform scale, free of normal errors of photography) are useful. With these products of photogrammetry, mapping of any area to the actual size, shape and position will come to reality.

**Photogrammetry in India**

National Remote Sensing Agency in India, is the authorized agency for carried out the aerial photography for commercial users of various government and private agencies. Aerial photography was also carried out mostly in the past for disaster management like flood, earth quake, landslide, forest fire, coal field monitoring etc., Various types of sensors like black and white, colour, infra red, multispectral scanner are been employed for aerial photography in India. Because of the highly restricted nature of aerial photography, the use of photogrammetric techniques was confined to a smaller circle. This was originally practiced by Survey of India, National Remote Sensing Agency and other state Remote Sensing Agencies. Aerial Photography can be had by any government or private companies after getting the clearance from ministry of defence.

**Potential for Photogrammetry**

Due to the invention of computers the era of analog photogrammetry systems (fully manual) took a change towards analytical systems, where most of the computations were performed automatically through use of computers. Due to further advancements in the field of computers, new techniques of object and pattern recognition, high-speed processors, large storage disk space etc., digital photogrammetry has come to existence. Because of the various advantages and speed of processing of data in digital environment with a very low cost, digital photogrammetry has got a good potential in the world market.

Aerial Photography and the outputs of Photogrammetry can be used for town planning, utility mapping, tax assessment, flood mapping, forest fire mapping and monitoring, mining, Earth Quake / volcanic damage assessment etc. The police can use these technology for crime analysis and riot management. Highway planning, Railway alignment, pipeline survey, Irrigation canal alignment and management, New layout designing, 3D City modeling, power line monitoring are few other application areas.

Close Range photogrammetry, a branch of photogrammetry is nowadays been used extensively in the field of medicine, various industries etc., The permanent stereo record of the existing monuments and archeological importance structures can be made with photogrammetric techniques.

In India many municipal and metropolitan authorities of various town and cities are in need of large scale accurate mapping for the infrastructure development and planning activities. Bangalore Development Authority, Hyderabad Metropolitan Water Supply and Sewerage Board, Rajasthan Urban Infrastructure and Development Programme etc, TCPO under MoUD., had already started using these technologies to create large scale maps for use in Geographic Information System (GIS).

Private participation in the field of digital photogrammetry also are increased. So many companies like Infotech Enterprises Ltd. - Hyderabad, DSM soft (P) Ltd. - Chennai, Kampsax India (P) Ltd. - Delhi, Rolta India, Mumbai, Speck Systems Hyderabad, Genesis of Bangalore, IIC technologies of Hyderabad and so many other companies are practicing digital photogrammetry in India. As of now the job potential in these industries are more for trained and skilled Photogrammetry operators and managers. In a recent study made, it was felt that the potential for large scale mapping and GIS activities are about 55,000 crore for India. Such an huge untapped market is present in India.

**Photogrammetry education in India**

Though, potential market for Photogrammetry exists in India, the formal education in the field of Photogrammetry is very less. There are very limited numbers of institutes which offer Photogrammetry course. Institute of Remote Sensing, Anna University has a unique four-year

bachelor program (Geo - Informatics) and a M.Tech Program in Remote Sensing which gives main emphasis on photogrammetry and Remote sensing. University of Roorkee, currently given the IIT status is also having very good curriculum for photogrammetry for its M.Tech program. Apart, IIT Kanpur, Chennai, Mumbai also provides Master degree in Remote Sensing and GIS. Apart from these few other universities and colleges like JNTU, Hyderabad, BITS also provide Master's degree course on Remote Sensing and Photogrammetry.

In India, the Survey of India has its own "Survey Training Institute" (STI) - Hyderabad, which imparts training in photogrammetry. National Remote Sensing Agency (NRSA) also gives training in Photogrammetry, Remote Sensing and Geographic Information System (GIS) in its main campus in Hyderabad and in Indian Institute of Remote Sensing (IIRS) - Dehradun. Apart from this Institute of Remote Sensing, Anna University - Chennai is also conducting training programs in photogrammetry. Other than these government agencies many other private companies are also giving training on the basic theories and operation of various commercial digital photogrammetric systems.

We need to accept that the state of art facilities in the field of Photogrammetry is largely absent in many of the institutes. Availability of trained and highly skilled staff in teaching the fundamentals of Photogrammetry is very less. Many of the private training institutes except a few, wants to cash on the potential market. So the fresh graduates from various disciplines are trained on commercially available digital Photogrammetry software for stereo perception and were certified for acquiring the Photogrammetry training on principles and concepts. Even though, the candidates were able to perform their jobs in private companies, they were not able to go forward in their career after a certain limit due to lack of technical competencies. This has created a wide gap in the Photogrammetry industry. It is a fact that many industries are still in look out of potential candidate to head their divisions independently.

It is a fact that many of the GIS and RS professionals are not aware of the concept of scale and its related accuracy factor in terms of information content and positional accuracy content. Because of the availability of cheap and skilled manpower, Indian companies are able to get more projects. But the companies also should realize that apart from just a 3D data conversion companies, they should get transformed into the complete solution providers in this area. So they also need to encourage the staff and provide guidelines for their staff in identifying the quality institutes offering Photogrammetry education.

### **Curriculum development**

Photogrammetry is an complex subject which need to have a trained, skilled with oral and written communication staff to explain the concept in Photogrammetry. The complete mathematical concepts and complex earth surface, geodetic concepts need to be explained to the students in a much simpler way. Any student can be made interested towards the subject in 2 ways.

1. Complex and dry subjects can be made interesting by the way of teaching with visual aids, creating competition among the students, with examples of live and day to day activities.
2. By creating a good job potential in the market for his/her career advancements

The job potential in India for photogrammetrists is more in the current market. It is now with the institutes to produce quality and skilled manpower. The Institutes need to find the ways and means of augmenting their existing facilities with the state of art software and hardware. In the current scenario, there are many commercial software available with varied functionality and cost. There are software which are available for lesser cost which can suit for educational version in understanding the concepts.

**Virtual campus**

The use of computer networks and information technology are becoming an important part of the everyday work on almost any profession, especially in the scientific areas and changed education concepts. Some of the institutes / universities and software vendors or distributors can plan new strategies concerning computer based technologies and to start virtual campus for students to learn the Photogrammetry technology through the internet. The concepts and materials can be explained through multimedia presentations. Computer Aided Education is well in practice in other fields. These methods have been utilized and developed more than for fifteen years in many universities and organizations. The goal of this is to develop the learning capacity of students and increase the teaching productivity and effectiveness of instructors with the help of advanced computer based technology. This technology should be an integrated part in the education. It is also desirable to use this technology to develop attractive courses for distance education. Another area of interest is to use computers, information technology and equipment to develop attractive and understandable demonstrations of basically tasks and typical projects in the field of Photogrammetry.

General awareness on the potential of the market also need to be created with the various government agencies and should be highlighted of the potential and use of the technology at grass root level.

To be in pace with the emerging technologies, new techniques and advancements like Computer Graphics and Data Visualization, Machine Vision and Image Matching Techniques, Advanced Computer Programming in Geomatics, Spatial databases, automatic feature extraction techniques with neural network and fuzzy logic algorithms, artificial intelligence system, principles of LIDAR / LASER etc., should be included in the curriculum. The curriculum also should be revised every five years keeping in view of advancements and potential demand in the field.

**Future of Photogrammetry in India**

The advancements in the field of Survey have reduced a lot of fieldwork that needs to be carried out in the field. The use of Global Positioning System (GPS) has now revolutionised the entire field of Survey and Photogrammetry. The initial steps of creating the stereo vision is now been greatly reduced in such a way that we can create stereo models without the brain staking efforts of orientation process. The use of digital cameras has also reduced the time taking process of processing the negative, creating the positive prints and then again scanning to work in digital environment. We can directly go for mapping after getting out of the aircraft. Some research works need to be carried out to make this operational for large production projects.

The availability and use of high-resolution satellite images like IKONOS, has now made the mapping on large scale to be a reality with a comparatively lesser cost. The availability of stereo satellite images has increased the potential in the field of satellite photogrammetry. The future Indian high resolution Satellites Cartosat I and Cartosat II proposed to be launched in the next 2 years may also increase the use of stereo satellite data at a relatively lower cost. With the availability of these stereo satellite images the creation of terrain to its true 3 dimensions can be attained for a larger area in comparatively lesser time at low cost. Large scale mapping for city planning can be done with these types of data very quickly. As these stereo satellite images are not much restricted as the aerial photography, city planning, Regional planning etc., can use these high resolution satellite images.

The very recent advancement is the Automatic Laser Terrain Mapping. The use of the LIDAR technique has now made the user community to get the 3 dimensional data of the terrain within no time. This is currently proved successful for large scale mapping in the western world. The operational use of this on large-scale mapping are planned to start in NRSA from 2004 for various

applications like powerline monitoring, high precision DTM and contouring, terrain mapping, forest mapping etc.,

**Facilities at NRSA for large scale mapping and GIS solutions using Photogrammetry technology**



## Conclusions

Photogrammetry is a very important tool in preparation of large-scale topographic mapping. Most of the city development plans can be made reality with these large-scale maps. Non availability of these maps in India is a greater drawback. Preparation of these maps with the conventional ground survey technique may take more time. By the time when the maps are finalised, the details may get obsolete due to the rapid changes and advancements. To meet the potential demand of large scale mapping needs, adoption of the modern technology is necessary. Trained and skilled manpower need to be produced by the way of innovative use of education and training. Universities and educational institutions should take the lead adopting the modern techniques and developments.